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THE CHEMICAL BASIS OF AXIAL POLARITY IN REGENERATION

I

WHEN a piece of a stem is cut out from a plant one or more new shoots will usually arise at the apical, and roots at the basal end of the piece. This phenomenon of axial polarity was explained by the older botanists as being due to a flow of shoot-forming substances to the apex and of root-forming substances to the base. The gathering of these substances at opposite ends of the piece was believed to be responsible for the phenomenon of polarity in regeneration. While this may or may not be correct, the writer has recently found facts which suggest an additional or a different mechanism for this polarity, namely, that the apical bud suppresses the growth of the buds situated more basally in the stem by sending out inhibitory substances in a basal direction.

The experiments were made on *Bryophyllum calycinum.* Each node of the stem of this plant has two leaves in an opposite position, and in the axil of each leaf is found a dormant bud capable of giving rise to a shoot. The line connecting two buds of one node is at right angles to the line connecting the two buds of the next node.

Experiment I.—A piece of stem, containing six or more nodes, is cut out from a plant, all the leaves are removed and the piece is put into a horizontal position with the line connecting the two buds of the most apical node vertical. In this case both buds in the apical node may begin to grow, but as a rule only the upper bud will continue to grow, while the growth of the lower bud will soon stop altogether or will

be considerably retarded. None of the buds in the other nodes will grow out. Roots will grow chiefly on the under side of the stem, but in the last node and at the cut end they may form on the upper side as well as on the lower side of the stem.

Experiment II. is the same as Experiment I., except that the upper apical bud is cut out. In this case the lower apical bud will grow rapidly, but in addition one or both of the buds of the node next to the apical will grow out. These buds never grow out when the upper apical bud is preserved and healthy.

Experiment III. is the same as the previous experiment except that the lower apical bud is removed, while the upper one is preserved. In this case, the upper apical bud will grow out, but none of the others.

It follows from these experiments that the upper apical bud inhibits or retards the growth of the lower apical bud as well as that of the rest of the buds; while the lower apical bud can not suppress the growth of the buds in the node behind. The writer has repeated these experiments in many modifications, among which those on longitudinally split stems are the most striking. The results were uniform.

All these observations are intelligible if we assume that a bud when it begins to grow produces and sends out inhibitory substances toward the base of the stem. These substances flow in the conducting vessels in the same half of the stem where the bud lies; when one apical bud is above and one below, the two buds in the next node are in a lateral position between the upper and lower half of the stem. Hence the inhibitory substances sent out by the upper apical bud can reach the two buds in the next node behind and inhibit their growth, since these buds lie directly below or on the lower level of the conducting vessels from the upper apical bud; while inhibitory substances sent out by the lower apical bud can not reach the buds in the node behind in large quantity, since these buds are on the upper level or slightly above these conducting vessels. When the two lateral buds grow out they will inhibit the growth of all the buds behind, each bud covering a territory of one half stem.

The alternative hypothesis assumes that since the apical bud is the first to grow out it will absorb all the shoot-forming material.[1] If we assume that the shoot-forming material has a tendency to rise this hypothesis may explain the facts also. But the following experiment, which seems crucial, decides in favor of the other assumption.

A piece of stem containing a number of nodes is suspended horizontally, as in the previous experiments, with the two apical buds in a vertical line. All the leaves are removed with the exception of those at the apical node. Here the petioles of the leaves are left attached to the stem, the leaves having been cut off. The petioles will wilt in a week or ten days, but until then will prevent or retard the growth of the apical buds in their axils. The buds in the next node will begin to grow out and as soon as the petioles have fallen off the apical buds will also begin to grow.

The next step is decisive for testing the two hypotheses. If the inhibiting effect of the apical buds on the more basal buds is due to the fact that the buds which grow out first attract all the material from the basal part of the stem, the buds in the node behind the apical one, which grew out first, should continue to outstrip in growth the apical buds which began to grow out later. But if the inhibiting effect is due to an in-

[1] This form of inhibition exists apparently in the leaf where the shoots which grow out first prevent other notches in the leaf from giving rise to shoots by absorbing the material needed for shoot formation. Science, 1917, XLV., 436; XLVI., 115; *Bot. Gaz.*, in print.

hibitory substance being sent in the direction toward the base by the growing bud, the most apical bud should soon outstrip in growth those situated in the next node behind, although the latter had an earlier start. For according to this theory, the most apical buds should be sending substances toward the base which inhibit the growth in the next bud; while the most apical buds receive no such inhibitory substances. The results of the experiment are quite clear. As soon as the petioles at the apex fall off the axillary buds at the apex begin to grow out and soon not only outstrip in size those of the next buds behind but actually retard or stop the growth of the latter. This phenomenon seems intelligible only on the assumption that a growing bud sends out substances toward the base of the stem which directly inhibit the growth of the other buds.

II

If the inhibition of shoot formation is due to special inhibitory substances it should be possible to show that the inhibition varies quantitatively with the mass of inhibitory substances produced in the growing bud, or with the mass of the latter. While the bud is too small for convenient quantitative experimentation, it can be carried out satisfactorily with the leaf. In a former paper the writer had shown that the leaf of *Bryophyllum* sends out material toward the base of the stem which favors root formation; and it also seemed possible that the leaf might send out substances in a basal direction which inhibit shoot formation. The sap from the leaf flows in conducting vessels situated in the same half of the stem where the leaf is attached.

When we suspend a stem of *Bryophyllum* with six or more nodes horizontally, and remove all the leaves except the two in the apical node, the stem will form no shoots as long as the leaves are alive, but an abundance of roots is produced in the stem. The two leaves, therefore, inhibit all the shoot formation in the buds situated basally from the leaf. When we remove one of the two apical leaves the axillary bud of this leaf will grow out and it will have the same inhibiting effect as the leaf in the previous experiment. We now make the following experiment.

Twelve long stems from which all leaves except one of the two apical ones have been removed are suspended horizontally, and the free axillary bud opposite the leaf is also cut out. Six stems are suspended with the leaf above, six with the leaf below. There is a striking difference in the two sets. When the leaf is below, shoots will develop either in the two lateral buds of the first node behind the leaf, or on the upper side of the second node behind the leaf. When the leaf is above, no shoots will develop in the next node behind the leaf but one shoot may grow in the second node behind the leaf, *on the lower side alone.* These shoots will develop more slowly than those in the stems whose leaf is on the lower side.

This is exactly the result which we should expect if the leaf sends out substances inhibiting shoot formation toward the base of the stem. These substances, being identical with or accompanying the root-forming substances, flow on that side of the stem where the leaf is, but have naturally a tendency to flow downward and not to flow upward. Hence, when the leaf is below it is possible for shoots to form in some (about 50 per cent.) of the stems in the first node behind the leaf, in which case the buds are on the upper level of the flowing sap; while when the leaf is above it is impossible for the buds in the first node behind the leaf to grow because they are on the lower level of the sap flow from the

leaf. The bud on the lower side of the second node behind the leaf (when the latter is on the upper side of the stem) is outside the sap flow and hence it may develop.

When we work with a large apical leaf attached to a short stem (the free apical bud opposite the leaf is always removed in these experiments) containing only two nodes behind the leaf, everything is as described for long stems. When, however, the piece of stem behind the leaf is smaller, containing only one node, no shoot can grow on this stem even when the leaf is below. The mass of inhibitory substance sent out by a large leaf will flood the buds in this node with inhibiting material. Occasionally a bud starts to grow but stops before a leaflet has time to unfold. Such a stem will form an abundance of roots at the base. If, however, we reduce the size of the apical leaf by cutting away nine tenths of its mass, most or practically all the stems will form shoots in the node behind the leaf; but roots in such stems either do not develop at all or only with long delay.

The leaf, therefore, sends substances to the basal part of the stem which inhibit shoot formation and favor root formation, and the mass of these inhibitory substances decreases with the mass of the leaf, and apparently parallel with the mass of root-forming substances sent to the base of the stem.

Another experiment is equally instructive. We have seen that when long stems having all but one apical leaf removed (and the opposite free apical bud also removed) are suspended horizontally, with the leaf above, no shoot will form on the upper side of the stem. When we reduce the size of the leaf sufficiently this inhibition ceases.

Again the objection might be raised that the inhibiting effect of the leaf on shoot formation in the region behind the leaf is due not to an inhibitory substance being sent out by the leaf but by nutritive substances needed for the growth of shoots being sent into the leaf by the stem. This is highly improbable not only on the basis of our knowledge of these processes but also on account of the following fact. When we cut off a leaf without its petiole, leaving the latter in connection with the stem, the petiole will dry out and fall off in a week or less. If, however, the petiole is detached from the stem but left attached to a leaf, it will not wilt, but remain fresh and green as long as the leaf is alive, which may be many months. This shows that nutritive material is furnished by the leaf to the stem, and not vice versa.

III

While these experiments show that the inhibiting influence of an apical bud on the growth of the more basal buds is due to one or more inhibitory substances being sent toward the basal end of the stem, the other main fact of polarity remains unexplained; namely, how it happens that the most apical bud grows out first. The writer is inclined to offer the following suggestion: In the normal plant, the substances inhibiting shoot formation are constantly flowing from the growing region toward the root of the plant. When we cut out a piece of stem and remove the leaves these substances will at first exist in every node, but will continue to flow toward the base. Hence the most apical node will be the first one to be free from these inhibitory substances and the bud or buds situated here can now begin to grow out. As soon as they grow out they will maintain a constant flow of inhibitory substances toward the base which will suppress the growth of buds in the more basal part of the stem.

The experiments, therefore, seem to prove that axial polarity in the regeneration of a stem is due to the fact that the apical bud

(as well as an apical leaf) send out substances toward the base of a stem which inhibit the buds from growing out. These inhibitory substances may be identical with or may accompany the root-forming hormones. The most apical bud in an excised piece of stem will grow out first since it will be the first to be free from these inhibitory substances.

In a former paper the writer had pointed out that a leaf sends out substances, in an apical direction through the stem, which favor shoot formation.

JACQUES LOEB
THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH,
NEW YORK

SOME COMMENTS ON THE THEORIES OF THE STRUCTURE OF MATTER[1]

PROFESSOR LEWIS in his paper raised the question of valence. From the point of view of chemistry, valence has a definite meaning which can not be overlooked and which may be emphasized here. The conception of valence developed from a study of the regularities observed in the composition of substances, and is fundamentally purely descriptive. It is a classification which shows regularities in the capacity of certain atoms for combination, or for holding a definite number of atoms or their equivalents in combination. The continued study of chemical composition has, as a matter of course, extended the classification. The phenomena of oxidation, the ionization of substances in solution and otherwise, and similar properties, have brought forward the view that, choosing a suitable element or state of an element as the zero or neutral point, the valence of an element in a given combination may be denoted either by a positive number or a negative number. This view was adopted for individual cases some time ago by different chemists, but became of general interest when J. J. Thomson, using corpuscles, showed how this could be pictured readily, and applied in a simple manner.

A few words may be devoted to the fact that the classifications given by valence should involve no considerations of measures of relative stabilities of substances, although the existence of compounds depends upon stabilities and rates of decomposition. Stability discussions should not enter directly into questions of valence, but unfortunately this fact is often overlooked and much confusion has resulted.

The question of so-called polar and non-polar valence is one raised by Professor Lewis. At the present time the view that only non-polar bonds exist is probably held by no chemist. The electron conception of valence, based upon a study and comparison of organic and inorganic compounds, postulates polar valence only; in other words, each valence linking is equivalent to one atom functioning with a negative charge, and the other atom with a positive charge. The electrostatic view does not involve at first sight such questions as distri bution of electrons within the atom, etc.

At the present time there are a number of chemists who advocate both polar and non-polar valences, even assuming both to be present in a molecule at the same time. The reasons for assuming the existence of non-polar valences appear to be negative ones. If direct evidence is lacking, or if ignorance is manifested with regard to the reactions of certain groups, or if these groups do not take part in the desired reaction with sufficient velocity, the existence of polar valences is denied. A strong argument in favor of assuming polar valences in organic compounds is, that if they are

[1] This discussion was presented by Dr. Falk at the "Symposium on the Structure of Matter," held at the meeting of the American Association for the Advancement of Science in New York City, December, 1916.

not assumed, two different types of oxidation reactions become necessary, and these two types would be contradictory. This was pointed out several years ago.[2]

Direct evidence for the polar nature of valences involved in the Grignard reactions is given by some recent experiments.[3] Without going into details, these results may be quoted.

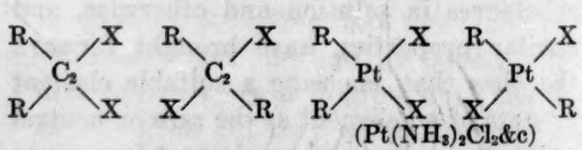
RESISTANCE IN OHMS. (ORDINARY CONDUCTIVITY APPARATUS)	
Ether	above 1 $\times 10^7$
Ether containing ethyl bromide..	above 1 $\times 10^7$
Ether containing 1.2 gm. magnesium as Grignard reagent (MgC_2H_5Br) per 100 c.c.....	7.1×10^3
Same with 0.3 mg. magnesium..	1.0×10^6
1/50 *M* KCl aqueous solution....	1.26×10^2

A cell constructed with magnesium and platinum electrodes, and a dry ethereal solution of ethyl bromide containing a small amount of previously prepared Grignard reagent as solution gave electromotive forces of from 0.5 to 1.5 volts.

These results are of the greatest significance with regard to the question of polar and non-polar valence and indicate that the valence or linkings of organic compounds are of the same character as those of inorganic compounds. They bear out the explanation of the Grignard reaction on the basis of the electron conception of valence published several years ago, and in addition will unquestionably throw light on the processes operating in solutions, aqueous and otherwise.

With regard to Professor Jones's work on electromerism, some interesting developments may be presented. As we understand the term, electromerism means electronic tautomerism and includes substances structurally identical, but mutually transformable by an exchange of negative electrons between atoms composing the molecules. Thus ammonium nitrate, NH_4NO_3, and hydroxylamine nitrite, $NH_3OH\ NO_2$, while mutually transformable by a suitable exchange of negative electrons, since as far as the charges on the atoms are concerned they differ only in the valence of the nitrate and nitrite nitrogen atoms, are not structurally identical and would not, therefore, be classed as electromers.

Professor Jones in his paper considered electromeric nitrogen compounds. In electromers, the states of oxidation of certain atoms in the structural isomers are different. A number of years ago we showed that the explanation of the isomerism of a number of structurally identical organic compounds may be referred to the state of oxidation or the valence of certain atoms. The compounds referred to are generally known as geometrical or cis-trans isomers. Direct evidence based upon the ionization constants of organic acids[4] showed that the isomerism of maleic and fumaric acids is due to phenomena now included under electromerism while addition reactions of unsaturated carbon compounds lead to similar conclusions.[5] The evidence in detail is given in the published papers and need not be repeated here. It is possible to go somewhat farther. Werner and Pfeiffer[6] have placed in parallel the so-called geometrical isomerism of double bonded carbon atoms and the isomerism due to plane configuration of certain cobalt, chromium and platinum compounds:



[2] Falk and Nelson, *Jour. Amer. Chem. Soc.*, 36, 209 (1914).

[3] Nelson and Evans, *ibid.*, 39 (1917) (January).

[4] Falk, *Jour. Amer. Chem. Soc.*, 33, 1140 (1911).

[5] Nelson and Falk, *School of Mines Quarterly*, 30, 179 (1909); Falk and Nelson, *Jour. Amer. Chem. Soc.*, 32, 1637 (1910).

[6] Werner, "Neuere Anschauungen auf dem Gebiete der anorganischen Chemie" (1913), pp. 343, 345; Pfeiffer, *Ztschr. physik. Chem.*, 48, 40 (1904).

Whatever explanation is accepted for the double bond isomerism, the same explanation will apply to the isomerism of the platinum compounds. Werner considers that the explanation of the spatial configuration applies to both. On the other hand, if the double bond isomerism is due to the directions of the valences which is the same as the distribution of the negative electrons in the acids, then the explanation of the isomerism of the platinum compounds should be based upon the distribution of the electrons in the platinum atom. There is, however, only one atom involved here, so that it appears as if this isomerism would furnish a method for showing the distribution or arrangement of the electrons in an atom, or perhaps the spatial configuration of the atom, different arrangements of electrons giving rise to possibilities of the existence of isomeric compounds. It is even possible, and perhaps very probable, that the different arrangements of the electrons might control the spatial positions of the combined groups. The spatial configurations deduced by Werner and others, then would exist, but would actually be an effect of the arrangement of the electrons. The positions of the combined atoms therefore would be a result of the isomerism and not its cause.

These platinum and similar metal compounds would then belong to the class of electromeric substances. Since this explanation means that the spatial arrangement of atoms or groups around a central atom depends primarily upon the spatial arrangement of the valence and also other electrons of that central atom, a further logical deduction would include all optically active isomers in organic and inorganic chemistry in the group of electromers. The spatial arrangements of the atoms or groups here would also be governed or controlled primarily by the arrangement of the electrons of the atom showing the optical activity.

K. GEORGE FALK,
J. M. NELSON

HARRIMAN RESEARCH LABORATORY,
ROOSEVELT HOSPITAL,
COLUMBIA UNIVERSITY

POSSIBILITY OF USING GRAVITY ANOMALIES IN THE SEARCH FOR SALT-DOME OIL AND GAS POOLS

THE immense masses of common salt that have forced their way up toward the surface of the earth in Louisiana, Texas and other low plains regions where there is no hard rock within several thousand feet of the surface, seem to afford all the fascination and baffling questions that can be desired by the structural geologist, though thrilling encounters with such questions are usually sought in mountainous regions. Recorded and available notes on experiences in the sinking of the thousands of wells that have been put down on salt domes in the search for oil is dishearteningly scant, and yet sufficient to give a fair idea of the common extents, positions and shapes of the upper portions of the salt cores. If as much were known concerning their lower portions it might not only be possible to determine their cause and mode of growth with a fair degree of certainty, but to devise means of discovering by gravity observations, hidden domes, for some are scarcely evident from the surface, and perhaps many unsuspected ones with valuable oil and gas pools are scattered through the coastal portions of Louisiana, Texas and other regions.

Are the salt domes due to some process related to volcanic action? The domed form of the strata, which is much more commonly seen than the core itself, is such as might have been produced by a rising plug of igneous rock and even the masses of salt and associated secondary deposits might apparently have been produced indirectly by intrusions. On the other hand, though many very deep wells have been drilled in salt domes, igneous rock has rarely if ever been touched. Since there are numerous varieties of salt domes—some making a

conspicuous hill, some through recent solution of the salt making a depression, and some having little or no effect on the surface, the salt core of some lying at slight depth and of others at great depth—it would appear that if they are due to intrusion, the igneous rock should have been found in some of them.

Furthermore, in areas of igneous activity intrusions have various forms, dikes being common, but salt domes are sharply localized, more or less equi-dimensional laterally, in length and breadth rarely measuring over two or three miles or less than one half mile. Although in an area underlain by a great thickness of unconsolidated strata intrusions may differ somewhat from those of other areas, still, since the country rock, being unconsolidated, is more likely a body of water than if it had been cemented into stone, it seems quite unreasonable to assume that either intrusions or secondary deposits made by circulating waters or gases emanating from them would be similar in form and size and short in lateral dimensions. The fact that salt domes are found on the northwest and southwest coasts of the Gulf of Mexico, and that, due perchance to more consolidated rock, igneous intrusions are common in territory between, invites investigation to determine whether or not gradation phases may be found between salt domes and intrusions. Such phases, however, seem to be poorly developed and the series, if there is one, incomplete. Also, although intrusions have made dome structures and hills on the surface in many parts of the world, no evidence of an overlying salt core seems to have been found.

Are the domes due, as has also been suggested, to forces of crystallization acting in some such way as they do in the growth of concretions, the salt being taken from saturated solutions and collected around some nucleus by molecular attraction? Ordinarily salt does not seem to behave in this way and the associated great deposits of dolomite, gypsum and other secondary substances would seem too much to ascribe to a kind of mass action not controlled by some other set of forces operating at or underneath the locus of salt-dome growth. The apparent lack of concentric structure and of small salt concretions, and the presence of certain minerals, such as sulphur and copper ores, seems to point to a deep-seated cause for the domes.

May the salt domes be due to a buckling and flowage of one or more beds of rock salt lying at great depth, as has been suspected concerning European salt domes or more indirectly to some process of isotatic adjustment? If so some of the salt cores should be connected below with the parent stratum or strata of rock salt, and the average mass of salt perhaps much greater than if it had developed in some other way. However, since the country rock is largely unconsolidated, and, on the whole, homogeneous, and the surface is smooth and horizontal, it would seem rather improbable that the bodies of salt could have been produced through differential pressure, though it must be admitted that a small stress difference operating for a very long time may accomplish a great deal, and once started the process might be somewhat self-accelerating. Also the association of salt, dolomite, gypsum, sulphur, copper, etc., suggests a Permian source. As a matter of fact, however, the few determinations of specific gravity of the country rock that have been made indicate that it weighs in its natural wet state no more than salt, if indeed as much, and it seems very improbable that there has been any considerable horizontal thrust pressure.

In any case from what has been learned by deep boring and from the various conceivable possibilities as to salt dome origin, it seems probable that the known upper portions of salt cores are underlain with (*a*) more salt, (*b*) clay and sand, or (*c*) igneous rock. Although it is possible that the clay and sand strata through which the salt rises, differ more or less markedly from it in specific gravity, the surprisingly little information available on the subject indicates that in their natural state the salt is appreciably the heavier. The writer has tested seven samples of common sandy clay and clayey sand from the Gulf Coast region, and the results indicate that although the specific gravity varies considerably, it is not far

from that of salt. There is a real possibility, however, that the difference is great enough so that large bodies of rock salt not far from the surface can be detected by determinations of the intensity of gravity.

While investigating the "mud lumps" at the mouths of the Mississippi a few years ago the writer had occasion to study isostacy a little, for it seemed probable that the "mud lumps" were due to gravity—induced internal flowage of the delta. The question arose, may not the salt domes be due to some such solid or semi-solid flowage? and another question immediately arose, namely, may not the domes have a perceptible effect on gravity? The domes of southern Texas and Louisiana are in a region that is very flat, and although some domes are marked by knolls from two to three to thirty feet or more in height, some domes that are very high structurally have little or no effect on the surface. Whether this indicates that many domes are antecedent to the surface deposits has not been determined. In any case the means now available for finding domes not marked by a hill or basin on the surface seem to be limited to scant and irregularly developed secondary deposits at the surface, such as the curious "paraffin earth" which is apparently a new compound, though containing possibly both gelatinous silica and some hydrocarbon.

Since the domes are in a flat region underlain by comparatively homogenous sand, silt and clay, it seems more than likely that the salt, dolomite, gypsum, sulphur, compressed clay and possibly igneous rock of the domes would together have a specific gravity noticeably different from that of the country rock in which they occur, and within the range of possibility that the difference could be detected by gravity observations. In other words it seems possible that hidden salt domes, with the immensely valuable pools of oil and gas that are commonly associated, can be discovered through the help of gravity observations, which will thus reduce to a greater or less extent the cost of finding the oil pools.

The intensity of gravity varies with altitude, latitude, topography and the varying density of the materials composing the earth, particularly near the points where the observations are made.

> A mass weighing 200 pounds at sea level at the equator will weigh [on a spring balance] approximately 201 pounds at sea level at either pole. A mass weighing 400 pounds at sea level will weigh approximately 399 pounds at an elevation of 5 miles at the same latitude; and a given mass will weigh less at the top of a sharp mountain peak than if it were at the center of a broad plateau of the same elevation as the peak. . . . The measurement of the force of gravity at a station to be acceptable must not have a probable error greater than one part in two hundred thousand. An actual error of one part in two hundred thousand corresponds to an error of only one one-millionth of a second in the period of oscillation of the pendulum.[1]

The method of observation, consists essentially in determining the effect of gravity on the rate of swing of a pendulum. The instrument "is placed on a solid concrete floor or an especially prepared brick or concrete pier." With the interferometer, vibrations of the case "due to the passing of a team a city block away or a team a mile away are easily detected."

The average probable error in the gravity observations of the Coast and Geodetic Survey is said to be in general about .002 or .003 of a dyne.

> If we assume that the force of gravity at the center of a section [square mile] which is underlain with sand one mile deep at a specific gravity of 2.50 is 980,000 dynes, then if the [cubic mile of] sand were replaced by limestone at a specific gravity of 2.75 the force of gravity would be increased to about 980.005 dynes. Similarly, if the same were replaced by basalt at a specific gravity of 3.00 the force of gravity would be increased to about 980.010 dynes. The change in the force of gravity at the center of the adjacent section due to these changes in specific gravity would be about one fifth as much as in the section affected.[2]

Apparently, if a cubic mile of clay and sand with a specific gravity of 1.80–2.00 immediately

[1] U. S. Coast and Geod. Survey, Spec. Pub. No. 23, pp. 48 and 50, 1916.

[2] Letter to writer from acting superintendent Coast and Geod. Survey, April 4, 1916.

underlying the surface were replaced by common salt with a specific gravity of 2.10 or 2.20, the effect on the intensity of gravity might be observable. If a still heavier mass made up of salt, dolomite, igneous rock, etc., having a specific gravity of 2.50 to 2.75 were intruded the rate of swing of the pendulum would be very perceptibly increased. If, however, only a quarter of a cubic mile of the clay and sand were replaced with the lighter or heavier substances, the effect would scarcely be observable, and if the intrusion occurred several thousand feet below the surface it might not be possible to locate the position with the gravity instrument. Other instruments have been devised for measuring the intensity of gravity that do not make use of the pendulum, and it seems within the range of possibility that in time an instrument of some sort will be perfected by which more delicate observations can be made.

The writer has found but one published statement suggesting the use of gravity anomalies in the search for oil, and this was not intended to apply in the way here outlined. Eötvös,[3] in 1913, suggests that it may be possible to find water, ore, coal, salt, oil and gas by using gravity anomalies. David White[4] has, however, studied the relationships between gravity anomalies and character of rocks.

On account of the slight variations in altitude and latitude in southern Louisiana and Texas and other regions where salt domes occur, it seems possible that a considerable part of the calculations made in connection with the occupation of stations for other purposes may be eliminated. The use of gravity observations in the search for salt domes would then consist essentially in determining at many points the number of beats in a unit of time of a pendulum so constructed and encased as to reduce the friction to the lowest point possible. If the material in many of the domes will perceptibly affect the number of beats then it may be that gravity anomalies can be used profitably in searching for hidden domes, the observations for most points in a county or group of counties being uniform, while at a few points a perceptible departure can be observed. The increasing value of oil and the keen interest in prospecting make it seem possibly worth while to make some practical tests with the gravity instrument on a known salt dome and surrounding country, especially since many wells are being sunk at random in the region. To be sure, some salt domes are known which do not seem to have oil pools, and others are known which have not yet been fully tested, but the number of insufficiently tested domes is rapidly decreasing, and with the keener interest in the search for oil the time will no doubt soon come when it will be profitable to spend a great deal of money searching for salt domes, for they seem to be much more likely to contain oil than the surrounding country.

Eugene Wesley Shaw
U. S. Geological Survey

[3] Eötvös, Roland, Ungarn. Bericht über Arbeiten mit der Drehwage ausgeführt im Auftrage der Kön. Ungarischen Regiergung in den Jahren 1909–1911: Internat. Erdmessung, 17 Allg. Conf., Hamburg, 1912, Beilage *A*, XL., pp. 427–438, 1913.

[4] White, David, "Discussion of Gravity Anomalies from the Stratigraphic Standpoint" (no abstract). Discussed by William Bowie: Washington Acad. Sci. Jour., Vol. 7, No. 10, p. 312, May 19, 1917. Meeting of Geol. Soc. of Washington on March 14, 1917.

ANNUAL FIELD TRIP OF THE AMERICAN ASSOCIATION OF STATE GEOLOGISTS

The American Association of State Geologists made a very pleasant and instructive trip through Oklahoma, October 12 to 16. At the winter meeting in Albany, in December, 1916, it was decided to hold the summer field meeting in Oklahoma, and the Oklahoma Geological Survey accordingly made very comprehensive plans for the entertainment of the association.

The declaration of war and the consequent interest of the geologists in war materials lead to the combination of the first part of the field trip with the meeting of the American Institute of Mining Engineers.

After the meeting of the American Institute of Mining Engineers ended at Drumright the

State Geologists' Association left the American Institute and continued the excursion outlined by the Oklahoma Geological Survey. The association was fortunate in having with it Mr. A. A. Snietkoff and Ivan C. Goubkin, members of the Russian Commission, and A. Stepanoff, their secretary and interpreter, and also Mr. David White, chief geologist of the U. S. Geological Survey.

The party arrived in Oklahoma City, where they were dinner guests of the Oklahoma Geological Survey. At this dinner President and Mrs. Brooks of the university honored the association with their presence. The next morning the party went to Lawton, where the Businessmen's League conducted them on an automobile trip through the Ft. Sill Military Reservation, Medicine Park and through the Wichita Mountains to the United States Forest and Game Preserve. The hospitality exhibited on this occasion will long be remembered by every one of the party. On the following morning automobiles were again used for a trip through the Lawton oil and gas field, where some new gas wells with enormous capacity have recently been brought in. By courtesy of the owners, the Keys well No. 2 was opened in order that the visitors might have the opportunity of seeing one of the largest gassers ever drilled in the state. The capacity of this well is estimated at 60,000,000 cubic feet per day and the rock pressure is in excess of 1,000 pounds, so large, indeed, that great difficulty is experienced in controlling the well. From this field the trip was continued by automobile through Waurika and Ringling to the Healdton oil field and the Fox gas district. After visiting the many interesting sights of this field the party was taken to Ardmore for the night, and in the evening were the guests of the Ardmore Chamber of Commerce at a concert.

The following morning the Chamber of Commerce provided machines to take the party north of the city into the Arbuckle Mountains. About two miles above Turner Falls the machines left the party and the trip was made on foot down to Turner Falls and across the mountains to Price's Falls, where they were again joined by the machines. The wonderful beauty of the Travertine Falls in this district was enjoyed by all members of the party, and it was particularly enjoyable because of the fact that a new bulletin by the Oklahoma Geological Survey on these phenomena had just been received that morning from the printer. The automobiles then took the party to Davis, where the Santa Fe train was taken for home. The party finally disbanded after dinner at the Harvey House, at Purcell.

A few members of the association stopped over at Norman and visited the State University before continuing to their homes.

W. O. HOTCHKISS,
Secretary

SCIENTIFIC EVENTS

THE LATE DR. RICHARD WEIL

The following minute has been adopted by the board of trustees of the New York Memorial Hospital:

Dr. Richard Weil, Major in the Medical Reserve Corps, U. S. A., died while on active duty at Camp Wheeler, Macon, Ga., November 19, 1917. By his death the Memorial Hospital loses one of the most highly trained and successful workers of its medical staff, and American cancer research one of its recognized leaders. Since 1906 Dr. Weil has been an active member of the staff of the Huntington Fund, and throughout this period of eleven years he was constantly engaged in the problems of cancer research. His contributions in the field of the serology of cancer and in the general problems of immunity gained for him an international reputation. He was one of the founders of the American Association for Cancer Research, and largely through his efforts was founded the *Journal of Cancer Research*, of which he was editor-in-chief. At the reorganization of the Memorial Hospital in 1913, Dr. Weil assumed the position of assistant director of cancer research and attending physician to the hospital, and in this capacity he labored energetically to establish an efficient organization of the routine and research work of the hospital. In 1915 he resigned the position of assistant director upon his appointment as professor of experimental medicine in Cornell University, but he continued without interruption his experimental work in cancer. Upon the declaration of war he was among the first to offer his services to

the government, and spent the summer at Fort Benjamin Harrison in the Medical Officers' Training Corps. Quite recently he was detailed to take charge of a large military hospital at Camp Wheeler, Macon, Ga., and here in the performance of strenuous military service he fell a victim to pneumonia. During his brief but brilliant career he attained eminence as a devoted laboratory worker, a skilful experimenter, a broadly trained clinician, and a forceful writer, while his untimely death places his name among the first on his country's honor roll in the great war.

MEDICAL INSPECTION OF CAMP WHEELER

Major-General William C. Gorgas, surgeon general of the army, has returned from an inspection trip to Camp Wheeler, Macon, Ga. His report to the chief of staff is in full as follows:

In my recent inspection of Camp Wheeler at Macon, Ga., I found conditions as had been indicated by reports. There had been a sharp epidemic of measles, some 3,000 cases, and, as always occurs with measles, a certain number of cases of pneumonia. At the time of my visit, there were some 300 cases of pneumonia in the hospital. While the hospital was crowded, the right of way was given the pneumonia cases, and they were being well cared for.

In the past month there have been about 60 deaths from pneumonia. The height of the measles epidemic was passed some 10 days ago, and at the time of my visit the epidemic was markedly on the decline, but the pneumonia does not develop until a week or 10 days after the incidence of the measles.

We can therefore expect a considerable number of deaths from pneumonia.

The camp is well situated and was in generally good condition. I think the reason for the measles affecting so severely this particular camp is the fact that the men came from the surrounding southern states which are sparsely settled and therefore the inhabitants do not, as a rule, have measles in childhood.

A large proportion of the cases of pneumonia were evidently contact cases, and I am anxious on this score, fearing that we may be beginning here an epidemic and septic pneumonia. We have had a few cases of meningitis, a few cases of scarlet fever and some cases of mumps.

Whatever the original cause of the epidemic and the present conditions, all these evils are accentuated by the crowded condition of the camp. The tendency to pneumonia has no doubt been increased by the fact that the men have generally been exposed to the cold weather of the past month with no other protection than their summer clothing. Clothing is now rapidly coming into camp, and about two thirds of the men are supplied with woolen garments.

I recommend that it be insisted upon that all men in the camp have 50 feet of floor space each and, to accomplish this, that such additional shelter be supplied as may be necessary; that no fresh men be brought into the camp until the epidemic has subsided; that an observation camp be established; and that all new men be kept under observation until the main camp is free from infection.

Accompanying General Gorgas were Colonel Dean C. Howard, of the Regular Army, recently health officer at the Canal Zone, where he was in charge of civil sanitation; Major Victor C. Vaughan, Marine Officers' Reserve Corps, professor of hygiene at the University of Michigan, dean of its medical faculty and president of the Michigan State board of health; Major William H. Welch, Marine Officers' Reserve Corps, professor of pathology at John Hopkins University and dean of its school of hygiene; and Major Theodore C. Janeway, Marine Officers' Reserve Corps, professor of medicine at Johns Hopkins.

Steps have already been taken to separate the men to a greater degree. By the use of tents which were held for new men due to be called to the camp and with 1,000 additional tents immediately shipped, the number of men per tent can be reduced from nine to five. As new men come other tents will be provided for them. All the new arrivals will be kept away from men who have been some time in camp to minimize the danger of contagion. This carries out Gen. Gorgas's recommendation that an observation camp be established for new men.

The supplying of sufficient clothing has been delayed by the necessity of equipping first those divisions in northern latitudes and those which have been sent abroad. The men at Camp Wheeler now have a good supply of warm underwear and heavy outside clothing

was shipped some days ago. It should be arriving at the camp now, but congestion of railroad traffic has caused some delay in its delivery.

There are over 22,600 men at Camp Wheeler.

THE USE OF THE McKAY BEQUEST TO HARVARD UNIVERSITY

HARVARD University can not share the Gordon McKay bequest with the Massachusetts Institute of Technology, according to the decision by the full bench of the Supreme Court which declares invalid the agreement between the two institutions under which Harvard suspends its instruction in applied science and devotes three fifths of the income of the McKay endowment to the maintenance of the engineering departments at the Institute. The decision is on the petition of Harvard to have the court ratify the agreement. It means that Harvard, which abolished the Lawrence Scientific School to merge its scientific courses with those at Technology, will have to reestablish a school of applied science under its administration. The court, in its decision, written by Judge DeCourcy, says:

We are constrained to instruct the plaintiff corporation that it can not lawfully carry out this agreement between it and the institute, as far as respects the property received by the university under the deeds of trust and the will of Gordon McKay.

In substance the plan agreed upon between Harvard and the Institute of Technology devotes three fifths of the endowment to an engineering school, which is not only located at the institute but is conducted and controlled by the institute instead of by the university. We can not assent to the assertion of counsel that "the school of applied science on the Charles River embankment is a Harvard school, a department of Harvard University."

Education and research in the five branches covered by the agreements are to be transferred from the university to the institute, and there conducted under the provisions of the agreement as part of the latter's curriculum. The Harvard professors associated with those courses shall become members of the faculty of the institute, and the property and equipment which the university may hold for the promotion of instruction in industrial science shall be devoted to the courses so conducted.

The faculty which determines the conditions of entrance, prescribes the courses that lead to degrees, largely shapes and carries to practical application the instruction and discipline of the school, and mainly influences the appointment of professors, is the faculty of the institute, notwithstanding that 14 of its 120 members come from the university.

The effective instrument is the deed of trust executed October 30, 1891, and confirmed by a codicil November 5, 1891. McKay was then seventy years of age. He had been a successful manufacturer and inventor of machinery. He was a man of artistic tastes, a lover of music and had traveled extensively in Europe. From 1864 or 1865, for more than twenty years, his home was in Cambridge, near the college yard; he took a leading part in supporting the Symphony concerts in Sanders theater and was brought into friendly relations with many of the college teachers and students. He appreciated the advantages of combining training in the exact sciences with liberal culture in the atmosphere of the university. During all those years there was a close personal intimacy between him and the late Professor Shaler, long connected with the university and appointed dean of the Lawrence Scientific School in 1891; and with the latter McKay discussed his scheme for the disposition of his fortune.

The income of the McKay endowment must be administered according to the intention of the founder, Gordon McKay, even though it be at variance with our views of policy and expediency.

Reading this instrument in the light of the circumstances already referred to it seems reasonably clear from its expressed provisions and implied limitations that Mr. McKay intended that not only the investment of the endowment fund, but the education which his endowment was to make possible should be under the control and direction of the university, its government and administration.

He selected as a trustee to carry out his purpose a great educational institution, one whose ability adequately to carry out his plans he was familiar with, and with whose historic name he desired to associate his own in perpetual memory.

In our opinion this intention of Gordon McKay is not in fact carried out in the agreement in controversy, as we have construed its provisions in their practical operation.

ANNUAL MEETING OF THE AMERICAN ORNITHOLOGISTS' UNION

THE thirty-fifth annual meeting of the American Ornithologists' Union was held in

Cambridge, Mass., from November 12 to 16. The election resulted in the choice of the following officers for the ensuing year: John H. Sage, Portland, Conn., *President;* H. W. Henshaw and Dr. Witmer Stone, *Vice-Presidents;* Dr. T. S. Palmer, 1939 Biltmore St., Washington, D. C., *Secretary;* and Dr. Jonathan Dwight, *Treasurer;* the members of the council were all reelected. The single vacancy in the list of fellows was filled by the election of P. A. Taverner; two additions were made to the list of honorary fellows, Dr. A. H. Evans, of Cambridge, England, and W. L. Sclater, of London; and Dr. F. E. Beddard, of London, was elected a corresponding fellow. R. H. Beck, W. S. Brooks, James B. Chapin, Francis Harper, and Winsor M. Tyler, were elected members and 113 associates were added to the rolls.

The public meetings which were held in the Museum of Comparative Zoology were well attended and the program was more varied than usual. Papers were presented on the birds of several distinct parts of the world, including northern Canada, Costa Rica, Nicaragua, British Guiana, Peru, Chile, Falkland Islands, China and Africa. In addition to the regular program the social features of the meeting included an informal reception at the Boston Society of Natural History, the regular subscription dinner, and an outing to the Ipswich sand dunes where the Ipswich sparrow and other characteristic birds were observed. The members also had an opportunity to examine the collections of the Boston Society of Natural History and the Museum of Comparative Zoology, including the celebrated Lafresnaye collection of foreign birds, and to visit some of the historic points about Boston and Cambridge.

The next meeting will be held in New York City.

GENERAL ANNOUNCEMENT OF THE PERMANENT SECRETARY OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The seventieth meeting of the American Association for the Advancement of Science, and the sixteenth of the "Convocation week" meetings, will be held in Pittsburgh from December 28, 1917, to January 2, 1918.

The Council will meet Friday morning, December 28, and each following morning, in the Council Room, Hotel Schenley, at 9 o'clock.

The opening general session of the Association, with address of retiring President Van Hise, on the Economic Effects of the World War in the United States, will be held at 8 o'clock P.M., on Friday, December 28 (not Thursday, as was at one time proposed), in the Carnegie Music Hall, followed by a reception in the foyer, tendered by the University of Pittsburgh and the Carnegie Institute to members of the association and affiliated societies, with accompanying ladies.

Hotel rates, railroad rates, facts concerning affiliated society meetings, and other information will be found in the preliminary announcement.

For all matters relating to the local arrangements, hotel and boarding house accommodations, not explained in the following pages, address Dr. S. B. Linhart, secretary, local executive committee, American Association for the Advancement of Science, University of Pittsburgh.

Nominations to membership and letters relating to the general business of the Association should be sent to the Permanent Secretary at Washington. It is strongly urged that each member should at least make an effort to secure the nomination of some desirable new member. Owing to the lateness in the year, those proposed may, if desired, have their membership date from January 1, 1918; but they will be entitled to all privileges at the coming Pittsburgh meeting. The payment of the $8 fee should be mailed to the Permanent Secretary's office, Washington, prior to December 18, so that membership cards and announcement may be mailed promptly, or the member may make payment in person during the meeting-week at the Registration Desk, Main Building, Carnegie Institute.

Official receipts for dues are mailed to members on the same day that their payments reach the office of the permanent secretary. For their own comfort, members are urged to send

their dues to the permanent secretary so far in advance of the meeting as possible. In this way they will receive their cards by mail at once and avoid the necessity of waiting in line to make payment at the meeting. Do not forget to bring your white Registration Card to Pittsburgh.

Members who have not previously paid their dues for the Pittsburgh meeting will please call at the office of the permanent secretary, Main Building, Carnegie Institute, after 9 o'clock on Friday, December 28, to receive their members' tickets. The office of the permanent secretary will be used throughout the week for registration purposes. Members will register and receive their badges after paying their dues.

All members of affiliated societies who are not also members of the American Association for the Advancement of Science are earnestly requested to register their names at the desk provided for that purpose in the office of the permanent secretary, in the Main Building, Carnegie Institute, in order that an estimate may be made of the number of persons in attendance at the meetings.

Attention is called to the following rule relating to members' families and other associates:

> Every member of the association shall have the privilege of registering members of his family as *associates* (not including men over twenty-one years of age) by paying the sum of three dollars for each person so registered, and shall receive for them badges which will entitle the holder thereof to such privileges as may be extended to the members generally by the local committee for the meeting.
>
> Members of scientific societies whose meetings are contemporaneous with or immediately subsequent to that of the association, and which are recognized by votes of the council as "affiliated societies," may become associate members for that meeting on the payment of three dollars. They shall be entitled to all the privileges of membership except voting or appointment to office, but their names shall not appear in the list of members printed in the report.

All dues and admission fees must be paid at the office of the permanent secretary, and the annual dues for 1918 should be paid before registering and receiving the association badge and program.

As changes of address in the printed list of members are made only by request of a member, members will please be particular in reporting any changes of permanent address, also the decease of other members, at the office of the permanent secretary.

The register for the Pittsburgh meeting will be open on Friday, December 28, and succeeding days, from 9 A.M. to 5 P.M., in the permanent secretary's office, Main Building, Carnegie Institute.

L. O. HOWARD,
Permanent Secretary, A. A. A. S.
SMITHSONIAN INSTITUTION,
WASHINGTON, D. C.

SCIENTIFIC NOTES AND NEWS

DR. WILLIAM GILSON FARLOW, professor of botany at Harvard University, has been elected a corresponding member of the French Academy of Sciences.

PROFESSOR VERNON KELLOGG has accepted an invitation to give the annual address to the Entomological Society of America, at the annual meeting in Pittsburgh, on December 29.

MR. DOUGLAS STEWART, assistant director of the Carnegie Museum, Pittsburgh, is chairman of the Committee on Scientific Exhibits for the meeting of the American Association for the Advancement of Science in Pittsburgh, December 28, 1917, to January 2, 1918. Those interested in these exhibits are requested to correspond with Mr. Stewart.

THE de Morgan medal of the London Mathematical Society has been awarded to Professor W. H. Young, of the University of Liverpool and the University of Calcutta.

SIR J. J. THOMSON has been nominated by the council of the Royal Society for reelection as president. Other officers nominated by the council are as follows: *Treasurer,* Sir A. Kempe; *Secretaries,* Professor A. Schuster and Mr. W. B. Hardy; *Foreign Secretary,* Professor W. A. Herdman; *Other Members of the Council,* Dr. H. K. Anderson, Sir G. T. Beilby, Professor G. C. Bourne, Professor A.

R. Cushny, Dr. M. O. Forster, Professor P. F. Frankland, Dr. J. W. L. Glaisher, Professor B. Hopkinson, Mr. J. H. Jeans, Professor W. H. Lang, Major H. G. Lyons, Dr. W. H. R. Rivers, Professor C. S. Sherrington, Professor R. J. Strutt, Mr. J. Swinburne and Professor W. W. Watts.

The July number of the *Observatory* contained a letter from Professor H. G. v. de Sande Bakhuyzen explaining the present position of the association, whose convention expired on December 31, 1915, the majority of the belligerent states having refused to continue their support under the existing convention. The death of General Bassot, the president; of Dr. Backlund, the vice-president, and of Professor Helmert, director of the Central Bureau, has left Professor H. G. v. de Sande Bakhuyzen the sole survivor of the committee of the International Geodetic Association. He had, in December, 1915, appealed to the members of the permanent commission of the association in the neutral states of Europe and in the United States, and had obtained from them sufficient support to keep the association alive until a date two years after the conclusion of peace. M. Raoul Gautier, of Geneva, has been elected president, and General Madsen, of Copenhagen, vice-president. Professor Bakhuyzen retains the office of secretary.

Dr. Richard M. Pearce, professor of research medicine, University of Pennsylvania, has been made director of the recently established bureau of medical service of foreign commissions of the American Red Cross.

Dr. Reston Stevenson, assistant professor in charge of physical chemistry in the College of the City of New York, has been commissioned a captain in the Sanitary Corps of the Army. As one of a group of five selected men he will shortly go to France, where he will be assigned to a French laboratory for special work, preliminary to its extension among the other chemists attached to the U. S. Army.

At the University of Michigan leaves of absence have been granted to Professor John D. Rue, who becomes captain in the Ordnance Officers' Reserve Corps; to Dr. Peter Field, who is captain in the United States Coast Artillery; to Dr. R. A. McGarry, instructor in dermatology, who leaves to take up military service; to Dr. Orlow B. Snyder, instructor in anatomy; Winthrop R. Wright, who has accepted a temporary position in connection with War work in the Bureau of Standards at Washington; and Assistant Professor C. W. Cook, of the department of geology, now engaged in special advisory work with a large steel corporation.

Professor L. D. Rowell, of Purdue University, has been commissioned a captain in the Engineer Officers' Reserve Corps and is now in active duty as the recorder of the Board of Engineer Troops, Washington, D. C.

Guy R. McDole, assistant in soils in the University of Minnesota and formerly research assistant in agricultural chemistry in the University of Nebraska, has enlisted in the Gas and Flame Regiment (Thirteenth Engineers), and has left for his new work.

Mr. Daniel Willard, of Baltimore, trustee of Johns Hopkins University and chairman of the advisory commission of the Council of National Defense, has been appointed to serve as chairman of the War Industries Board.

Professor George B. Thomas, of Colorado College, is on a year's leave of absence, during which time he will work with the Western Electric Company along lines of interest to the military authorities.

Mr. John W. Gilmore, professor of agronomy in the University of California, is carrying on a wheat campaign in California—handling the problems of proper seed, varieties for different regions, time of planting and related topics. Mr. Charles F. Shaw, professor of soil technology in the university is in charge of the soil survey in California, and is carrying on a state campaign for increasing the acreage of wheat lands now in pasture or idle.

Professor W. S. Ford, of Cornell University, who had charge of the senior electrical laboratory work, has left to accept a position as superintendent of power with the Vacuum Oil Company, Paulsboro, N. J.

Professor H. P. Barss, plant pathologist of the Oregon Experiment Station, presented an

address before the California State Horticultural Commission on November 19, on the bacterial gummosis of stone fruits with special reference to the serious outbreak along the Pacific coast this year.

WE learn from *Nature* that at the annual general meeting of the London Mathematical Society, held on November 1, the following were elected as officers for 1917–18: *President,* Professor H. M. Macdonald; *Vice-Presidents,* Professor H. Hilton, Professor E. W. Hobson, and Sir J. Larmor; *Treasurer,* Dr. A. E. Western; *Secretaries,* Dr. T. J. I'A. Bromwich and Mr. G. H. Hardy; *Other Members of the Council,* Professor W. Burnside, Dr. S. Chapman, Mr. A. L. Dixon, Miss H. P. Hudson, Mr. A. E. Jolliffe, Mr. J. E. Littlewood, Professor A. E. H. Love, Major P. A. MacMahon, and Professor J. W. Nicholson.

MR. W. DUDDELL, F.R.S., past-president of the Röntgen Society and of the Institution of Electrical Engineers, died on November 4, aged forty-five years.

SIR DAVID C. MCVAIL, professor of clinical medicine in St. Mungo's College, Glasgow, from 1889 to 1906, and author of contributions to physiology, died on November 4 at the age of seventy-two years.

THE deaths are also announced of Dr. J. Rambousek, professor of factory hygiene at the University of Prague, and an authoritative writer on industrial poisonings; of P. Malerba, professor of physiological chemistry at the University of Naples, and of M. E. Huet, one of the pioneers in electrology in France.

IN connection with or in response to the call of the President for volunteers, the attention of all technical men, *i. e.,* men skilled in any line of science or mechanical or electrical or chemical or ordnance or explosives or mining or ship-building or railroad or motors or metallurgy or building of aeroplanes or water supply or sanitation, etc., is especially invited to the need of the Army for such men—aged eighteen to forty—in sundry branches of the technical troops. Information may be obtained from Major J. E. Bloom, U. S. A., 266 Market Street, Newark, N. J.

A NUMBER of American military surgeons arrived in England during the fortnight prior to September 22, and took up duty in a number of hospitals in London and the provinces, and also in France, to which country about fifty of the seventy-five had been sent. These will only attend the military patients in the institutions to which they have been assigned, and have been so allotted that a number of doctors may be released for work among the civil population. There are now over 900 American medical men serving with the British forces in Great Britain and France.

A JAPANESE medical corps of one hundred men has gone to Rumania to help in the effort to control the epidemic of typhus fever in that country. The corps is divided into three sections—internal diseases, surgery and epidemics—each with its own chief. The headquarters of the corps will be at Jassy.

WILLARD E. CASE, of Auburn, N. Y., has made a gift to the New York Electrical Society the amount of which has not yet been made public, but which is sufficient to defray all the liabilities of the society and leave a substantial sum for the carrying on of its special work.

THE fifth annual Pennsylvania Welfare and Efficiency Conference was held in the House of Representatives, Harrisburg, on November 21 and 22. These conferences are held annually for the purpose of stimulating discussions on the problems of industries and labor, with special reference to the reduction of the enormous number of diseases and deaths, and the numerous industrial accidents. The fifth conference of industrial physicians and surgeons was held at Harrisburg, on November 20. At the morning session the medical and surgical problems of the staff of the largest industries representative of Pennsylvania were considered, and in the afternoon the question of industrial diseases was taken up.

CHILDREN in various parts of Great Britain are now busy collecting the horse chestnuts required for the manufacture of war munitions. The nuts have ripened more quickly in some districts than in others, and in some parts of

London the collection is well forward. It should again be pointed out that every ton of nuts gathered means a saving of half a ton of grain. Present indications are that at least 25,000 tons of nuts will reach the Ministry of Munitions, but this is only about one eighth of the estimated crop for the country.

UNIVERSITY AND EDUCATIONAL NEWS

A BEQUEST of $200,000 is left to Yale University by the terms of the will of the late Richard P. Sewell of Boston.

H. P. WOOD, head of the department of electrical engineering at the Georgia School of Technology, Atlanta, Ga., has been appointed president of the Academic Board of the United States Army School of Military Aeronautics, which has been established at the Georgia School of Technology.

PROFESSOR J. F. WILSON, who during the past year was professor of electrical engineering at Queen's University, Kingston, Ontario, has been appointed assistant professor of electrical engineering at the University of Southern California, Los Angeles.

DR. JOHN EDWARD MARR, F.R.S., fellow of St. John's College since 1881, university lecturer in geology at Cambridge University, has been elected to the Woodwardian professorship of geology in succession to the late Professor Hughes.

DISCUSSION AND CORRESPONDENCE

METHODS FOR PREPARING ANIMAL MATERIAL TO BE DISSECTED

POSSIBLY the most common fixing and preserving fluid used for dissecting material is formalin. It is relatively inexpensive and especially convenient for collecting expeditions where a concentrated fluid is desirable. Animals preserved in it have rigid joints, however, and every one is familiar with the disagreeable characteristics of such material during dissection. Alcohol is much better from the standpoint of the dissector, but it has limitations when used alone.

Some of the "embalming fluid" mixtures used in preparing human cadavers for dissection are also splendid for smaller animals. Those containing phenol, alcohol and glycerine with no formalin give relatively flexible joints and pliable tissues. They also render the material resistant to a large amount of drying in the open air of a laboratory during dissection. Phenol is a relatively non-volatile antiseptic, and glycerine is very effective in preventing drying. Alcohol counteracts the action of the phenol in the solution, on the hands of the dissector. A good and much used solution consists of equal parts of phenol, alcohol and glycerine. Another less expensive fluid with arsenic and considerable water added to the above was described by Dr. W. C. Lusk some years ago[1] with an excellent discussion of principles involved in preparing cadavers for dissection.

As penetration by such fluids is slow, the mixture should be injected through some large artery, a femoral or carotid in the case of mammals. Small animals may be placed in solutions of about 80 per cent. alcohol in water when it is not practicable to inject them. In such cases, the usual practise of making a slit, at least in the ventral abdominal wall, should be followed. After all the tissues have been fixed, the material may be removed to a container which holds an "embalming fluid," such as I have mentioned, much diluted with water. Ten or more parts of water to one of the "embalming fluid" may be used. In fact, I have kept material which had already been thoroughly fixed in either formalin or alcohol, for several years in a solution consisting of water with 1 to 2 per cent. of phenol and 5 to 10 per cent. glycerine, with or without a little alcohol. Single specimens thus preserved have been used in dissection for many months without deterioration, so long as they were not kept out of the solution for more than a few hours or so at a time.

It is customary in human anatomy to leave cadavers on the dissecting tables for months without soaking. The glycerine in their tissues is wonderfully effective in checking drying. Nevertheless, unless the atmosphere of the room is very moist a good deal of drying

[1] *Anat. Record*, Vol. 3, No. 1.

does occur. According to my experience, it is worth the trouble to give even such large bodies as the human, as much soaking occasionally as is practicable, in such a solution as I have just described. This should be done between class periods, at least twice a week, when the air of the room is at all dry.

When material comes to my hands already filled with formalin, I soak it in running water, for a number of hours, according to its size, to get rid of the formalin, before transferring it to a phenol-glycerine solution.

Material which has been thus prepared with a phenol-glycerine solution can be stored or shipped in airtight wrappings with no surrounding solution. In an important article on methods for preserving and storing cadavers Keiller[2] has described methods for preparing wrappings.

I have adopted the practise of shipping material, which has been thoroughly soaked in the dilute embalming fluid described in this article, in packages well wrapped and packed in excelsior. No fluid except that in the specimen is needed for a number of weeks, even in summer, if the packing is well done. There is much economy in weight, and expensive containers are not needed.

In some medical schools, cadavers are stored in airtight chambers with no fluid except for a dish of alcohol which keeps the atmosphere of the chamber saturated with alcohol fumes. This is the best of all storage methods that have come to my attention, for properly embalmed bodies, and it works well with other large vertebrates. I have found it successful in a warm climate, and I have never heard any criticism of the method by people who have tried it.

Much trouble from drying of material in the dissecting room can be avoided by keeping the air of the room very humid. Professor S. W. Ranson, Northwestern University Medical School, has called my attention to a device which he has found efficient in maintaining a humid atmosphere and which eliminates the drying troubles. This is the "Steamo Air Moistener," which can be obtained from "The Air Moistener Co.," 28 North Market St., Chicago. It is attached to steam radiators of various types. Directions are furnished for maintaining any desired percentage of humidity.

[2] *Philadelphia Medical Jour.*, December 29, 1900.

R. M. STRONG

ANATOMICAL LABORATORIES,
VANDERBILT UNIVERSITY MEDICAL SCHOOL

SCIENTIFIC BOOKS

Physical Chemistry of Vital Phenomena for Students and Investigators in the Biological and Medical Sciences. By J. F. MCCLENDON, Assistant Professor of Physiology in the University of Minnesota. Princeton University Press, 1917.

In this concise book of less than 200 pages of text Professor McClendon describes and discusses briefly some of the more recent applications of physical chemistry to the analysis of vital phenomena. The field, although no longer new, is very large and calls for much further investigation; hence finality is scarcely possible at present, and the author describes his purpose as largely practical and tentative: "to develop a tool for physiological research," rather than to produce a systematic treatise on the subject. The space assigned to the different topics under discussion is very unequal; many of these are presented in the barest summary, with little attempt to reconcile conflicting statements or to reach unifying conclusions; while others, particularly those in which the author's own chief researches have been made, are treated in considerable detail. The book is intended for advanced students and presupposes more than elementary biological and chemical knowledge in the reader; condensation is carried to an extreme, and in many places one receives the impression of a succession of abstracts, in which both the selection and the omission of material seem arbitrary. In the later chapters, which deal with the more specifically biological topics (amœboid movement, tropisms, cell-division, fertilization, muscular contraction, oxidation, production of light and heat), the space is quite insufficient for adequate discussion, and the ac-

count is condensed to a bare outline of the facts and points of view which the author considers important. At the end there is an appendix on the general chemical composition of organisms, followed by a large and varied literature list and an index of topics with the names of the authors of the chief papers. Much of the book thus forms a summary of recent research, and will be valuable to those desiring a record of progress in this field and a guide to the literature of its various departments.

The most original chapters are those relating to the determination of hydrogen-ion concentrations and the electromotor and osmotic properties of partitions, and here there is much that is ingenious, independent and suggestive. The author's improved methods for determining the H-ion concentration of blood are described in detail, with figures of apparatus and a useful chart for converting potentials into H-ion exponents. The use of indicators and buffer mixtures is also explained, and many valuable data are given in convenient form. The account of semi-permeable and porous partitions is especially timely and interesting; the phenomena of membrane-potentials, negative osmose and cell-permeability are described, and their relations to the physiological processes of secretion, absorption and stimulation are discussed in a clear and definite manner. The author supports the view that the bioelectric variations of potential are primarily the expression of variations in the osmotic and hence the electromotor properties of the protoplasmic surface-layers or plasma-membranes. Agents like salts, anæsthetics and cytolytic substances are regarded as producing their characteristic effects by modifying the condition of the plasma-membranes.

As a whole the book exhibits the defects as well as the merits of its extreme brevity and condensation. The author evidently wishes to be as concise as possible, and largely for this reason his discussion and statements of fact frequently appear dogmatic and lacking in much-needed qualifications. Certain explanations are incomplete or otherwise open to criticism. Thus to regard negative osmose as essentially a case of electrical endosmose seems inaccurate; in true electrical osmose both the solution and the porous partition are interposed as parts of an electrical circuit, and the energy for the transport is derived from a battery or other external source; while in negative osmosis the water passes spontaneously through the porous partition from the more concentrated to the more dilute solution. Certain diffusion processes offer a closer analogy; recent investigation has shown that when the partition consists of negatively charged material like porcelain negative osmose occurs in the case of those electrolytes whose anions diffuse more rapidly than their cations; and it seems preferable to regard the positively charged layer of water adjoining the surfaces of the pores as acting like a layer of cations and as being carried after the rapidly diffusing anions by electrostatic attraction. The phenomenon seems indeed to afford further evidence of the hydration of ions in solution. Exception may also be taken to the following statements: suspensoids do not exert osmotic pressure (p. 72); monovalent and bivalent cations are antagonistic to each other in the precipitation of colloids (p. 77); surface-active substances are repelled by water molecules (p. 66); in anæsthesia adsorption is at the basis of the whole matter (p. 140. N. B.: this seems contradicted by the positive temperature-coefficients of narcosis with chloral and alcohol as observed by Meyer); the sperm need only scratch the egg-surface to make it segment (p. 158); local reduction of surface-tension produces protrusion of the affected surface (p. 148). This last statement especially needs qualifying; it can be true only when the surface-tension equilibrates some other force (such as gravity), which of itself tends to cause outflow or protrusion of fluid. The force of surface-tension acts tangentially, hence the surface-layer of fluid must always tend to be drawn toward the regions where the tension is highest; this removal of fluid from the areas of lower surface-tension must (unless otherwise compensated) cause there *depression* instead of protrusion, as seen for instance in the case of a layer of water to which ether or alcohol

is locally applied. In the case of any curved surface, *e. g.*, of a suspended drop of fluid, the tangentially acting force due to surface-tension must similarly tend to draw the surface-fluid away from any area where the tension is locally lowered; for geometrical reasons this lateral traction is necessarily greater than the externally directed force acting on the surface-fluid at the same area—due to the radial component of surface-tension which compresses the drop and tends to cause outflow at that area; hence in this case also the surface-layer of fluid will tend to be withdrawn from regions of lower and heaped up at regions of higher surface-tension. If the drop is in contact with a solid, such displacements may by reaction cause movements of the drop as a whole. The author's account of the mechanics of amœboid movement and cell-division needs to be reconsidered, since he assumes throughout that protrusion or outflow always takes place at regions of lowered surface-tension.

The whole subject, however, is full of debatable questions, and in his preface the author expressly defers judgment upon most of these, urging that the present need is for further investigation rather than for theoretical discussion. Most of us will readily grant this, and it is as an aid to investigation that the present manual will find its chief usefulness.

The reviewer feels bound to point out that the book suffers greatly from carelessness in composition and proofreading. The responsibility for this is not the author's alone. A University Press should be careful to maintain high standards in such matters.

RALPH S. LILLIE

THE PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES

THE seventh number of Volume 3 of the *Proceedings of the National Academy of Sciences* contains the following articles:

The Cayleyan Curve of the Quartic: Teresa Cohen, Johns Hopkins University.

A Search for an Einstein Relativity-Gravitational Effect in the Sun: Charles E. St. John, Mount Wilson Solar Observatory, Carnegie Institution of Washington. A series of observations stretching over several years indicates that the Einstein effect does not exist.

Triads of Transformations of Conjugate Systems of Curves: Luther Pfahler Eisenhart, department of mathematics, Princeton University.

The Molecular Weights of the Triarylmethyls: M. Gomberg and C. S. Schoepfle, Chemical Laboratory, University of Michigan. After discussing factors influencing dissociation and the relation between dissociation and the nature of the aryl groups, seven triphenylmethyls are investigated in detail and various inferences are drawn from the graphs of their dissociations against their concentrations.

Sex-Determination and Sex-Differentiation in Mammals: Frank R. Lillie, department of zoology, University of Chicago. Discussion of the results of studies of the anatomy of twenty-two fetal free-martins ranging in size from 7.5 to 28 cm. Sex determination in mammals is not irreversible predestination; with known methods and principles of physiology we can investigate the possible range of reversibility.

The Crystal Structure of Magnesium: A. W. Hull, Research Laboratory, General Electric Company, Schenectady. The structure is analyzed by means of X-ray.

The Structure of High-Standing Atolls: W. M. Davis, department of geology, Harvard University. Attention is drawn to the relation of atoll limestones to their supposed foundation of volcanic rocks. The relative merits of the glacial-control theory and of Darwin's theory are discussed.

Studies of Magnitude in Star Clusters, VII. A Method for the Determination of the Relative Distances of Globular Clusters: Harlow Shapley, Mount Wilson Solar Observatory, Carnegie Institution of Washington. The median magnitude of short period variables is constant in each cluster and may be used to determine the distance of the cluster which, with one or two exceptions, is found to be greater than 30,000 light-years.

The Principal Axes of Stellar Motion: H. Raymond, Dudley Observatory, Albany, New

York. Three principal axes are determined along which the various groups of stars show markedly unequal motion.

The eighth number of Volume 3 of the *Proceedings of the National Academy of Sciences* contains the following articles:

Relation of Preferential Motion and of the Spectral-Class and Magnitude Velocity Progressions to Proper Motion: C. D. Perrine, Observatorio Nacional Argentino, Córdoba.

Growth of Isolated Sporophytes of Anthoceros: Douglas Houghton Campbell, department of botany, Leland Stanford University. The young sporophyte of *Anthoceros Pearsoni*, separated from its association with the gametophyte, is capable of limited growth in length and is able to mature normal spores and elaters from the young sporogenous tissue.

The Mesa Verde Types of Pueblos: J. Walter Fewkes, Bureau of American Ethnology, Washington, D. C. A morphological study of Far View House and other types of prehistoric buildings.

A Determination of the Ratio of the Specific Heats of Hydrogen at 18° and —190° C.: Margaret C. Shields, Ryerson Physical Laboratory, University of Chicago. The value 1.4012 closely in accord with kinetic theory and different from previous determinations at 18° C. is obtained; the value 1.592 is found at —190° C.

Note on the Coefficient of Total Radiation of a Uniformly Heated Enclosure: W. W. Coblentz, Bureau of Standards, Washington, D. C. The value 5.722×10^{-12} is found by direct measurement and agrees with that calculated by Millikan on the basis of his values for h and e.

The Development of a Source for Standard Wave-Lengths and the Importance of their Fundamental Values: Charles E. St. John and Harold D. Babcock, Mount Wilson Solar Observatory, Carnegie Institution of Washington. It is necessary to examine for pole effect; the problem of wave-length determination is not one of routine but one for real investigation.

On the Presence of Albumoses in Extracts of the Posterior Lobe of the Hypophysis Cerebri: John J. Abel and M. C. Pincoffs, Pharmacological Laboratory, Johns Hopkins University. Secondary albumoses and possibly peptones were found to be present in all the therapeutically used extracts of the posterior lobe of the hypophysis cerebri that were examined. The "Hypophysin" of the Farbwerke-Hoechst is not, as claimed for it, a solution of the isolated active substances of the pituitary gland but a mixture of albumoses with varying and unknown amounts of active and inactive constituents of the gland.

On the Rôle of the Thymus in the Production of Tetany: Eduard Uhlenhuth, Rockefeller Institute of Medical Research, New York. It would seem that thymus contains the substances which cause tetany and secretes them into the body from which they are removed by the parathyroids. Extirpation of the latter would thus cause tetany.

Evidence of Assortive Mating in a Nudibranch: W. J. Crozier, Bermuda Biological Station for Research, Agar's Island, Bermuda. Mating pairs of the nudibranch *Chromodoris zebra* are found to exhibit a rather high degree of correlation between the sizes of the two members. This is due to assortive mating, which may constitute an important influence tending to increase the numbers of larvæ.

Coral Reefs of Tutuila, with Reference to the Murray-Agassiz Solution Theory: Alfred Goldsborough Mayer, Department of Marine Biology, Carnegie Institution of Washington.

National Research Council: Suggestions relating to the new National Army by the Anthropology Committee of the National Research Council; First Report of Committee on Botany; Meetings of the Executive Committee.

Notices of Biographical Memoirs.

Edwin Bidwell Wilson

Massachusetts Institute of Technology, Cambridge, Mass.

SPECIAL ARTICLES

A RELATION OF ATOMIC WEIGHTS TO ATOMIC NUMBERS, AND A SUGGESTED STRUCTURE OF ATOMIC NUCLEI

The writer has plotted, for all the elements, ratios of atomic numbers to the corresponding

atomic weights against square roots of atomic weights. Although the values for successive elements vary somewhat irregularly, if averages are taken for successive groups of ten or twelve elements each it appears that there exists an approximate general linear relation of the form

$$\frac{N}{W} = 0.520 - 0.0088\sqrt{W}. \qquad (1)$$

N is the atomic number, and W is the atomic weight. The average deviation in N/W from this straight line, regardless of sign, is 0.008. Hydrogen alone was not included in this average.

The relation between N/W and any other power of W, such as $W^{\frac{1}{3}}$ or $W^{\frac{2}{3}}$, is not so nearly linear. Furthermore, if values of N/W are plotted against $\sqrt{W}$ for the odd-numbered and even-numbered elements separately, it is found that a number of curious and nearly exact linear relations exist. Unless these are accidental, equation 1 must express no mere empirical relation, but an actual tendency of atoms.

If atoms have the structure called for by Rutherford's theory, equation 1 must represent a property of the atomic nucleus. If the nucleus is built up of positive and negative electrons, equation 1 can be accounted for if it has a surface shell of positive charge and a volume distribution of negative charge. The values of the coefficients in (1) seem to indicate that the negative electrons in the *nucleus* are packed together like solid spheres; to each negative electron on the surface of the nucleus two positive electrons are attached, on the average. (A positive electron is very much smaller, and hence much more massive, than a negative electron. This is a common assumption in electron theory.) If the number of positive electrons (hydrogen nuclei) in the nucleus is p, and if p is numerically equal to W, then n, the number of negative electrons in the nucleus, is $0.480\ W + 0.0088\ W_{\frac{2}{3}}$. (It was this three to two ratio of the exponents of W that suggested the assumed structure of the nucleus.) The first term in the equation just given may be supposed to equal the number of negative electrons in the surface layer of the nucleus; then the second term is the number of negative electrons crowded inside. The latter are held together by the external positive shell; it is assumed that this shell tends to contract, perhaps under electromagnetic forces.

In very heavy atoms the number of negative electrons inside the nucleus is so large that they can not be held together by the positive contractile shell against their mutual repulsions. Hence there is an upper limit to atomic weights, and immediately below this limit atoms are unstable.

The nucleus-model described also is capable of illustrating isotopism. Those elements which have atomic weights not whole numbers may, as has been suggested by Harkins and Wilson,[1] each be a group of isotopes—in which case their atomic weights are averages. (This suggestion was first made by Soddy.) For those atomic weights at which the number of negative electrons inside the nucleus increases by unity one might expect that two stable systems could exist. Such atomic weights, as calculated by the equation for n given above, are 23, 37, 49, 59; for these values the number of negative electrons inside the nucleus is 1, 2, 3, 4, respectively. These values of W, then, should be critical values near which isotopes can exist most readily. It is at least interesting to note that, of the four atomic weights less than 60 which differ from integers by more than 0.16, the values of three are 24.32, 35.46, 58.68 (Mg, Cl, Ni), while Si = 28.3. It is known, moreover, that isotopes occur at neon, with atomic weights 20 and 22.

The atomic weights of elements heavier than nickel show no tendency to approximate to whole numbers, according to Harkins and Wilson. This is to be expected; because for those elements the number of negative electrons inside the nucleus increases more rapidly with the atomic weight, so that almost every heavy element is near a "critical" value of W.

JOHN Q. STEWART

PALMER PHYSICAL LABORATORY,
PRINCETON UNIVERSITY

[1] Harkins and Wilson, *J. Am. Chem. Soc.*, XXXVII., pp. 1383–1396, 1915.

A NOTE ON THE AEROBIC CULTURE OF ANAEROBES AT HIGHER TEMPERATURES

A possible inverse relation between the temperature and oxygen tension requirements of bacteria has been indicated by Rabinowitch[1] who showed that the minimum temperature requirement of certain supposedly ortho-thermophilic organisms refusing to grow aerobically below 50° C. could be reduced at least to 37° C. by anaerobic culture. Her results account for the finding of thermophilic bacteria as parasites in the human intestine by MacFadyen and Blaxall.[2]

We have had no occasion to confirm the work of Rabinowitch as to the anaerobic growth of thermophilic aerobes as lower temperatures but we have taken advantage of the opportunity afforded in a collection of obligative anaerobes to test the converse possibility, that is the aerobic growth of anaerobes at a higher temperature. A successful result would perhaps have provided a simple means of surface culture for purposes of isolation in certain cases but the results were clearly in the negative.

It does not matter for this purpose that some of these cultures are as yet incompletely identified. The list, showing sources and the identity of the known forms, is to be published shortly in the *Journal of Bacteriology* in a paper describing our work on the inhibitory action of gentian violet and its application in preventing spurious presumptive tests due to these organisms in the bacteriological examination of water. Cultures of *B. botulinus, B. tetanus, B. chauvei, B. œdematis maligni* and the Ghon Sachs bacillus, were included among the twenty-one. All were free from ærobic contamination, as shown by tests on agar slants at 37° C. although we can by no means be certain that some of the unidentified cultures do not consist of more than one species of anaerobic microorganism.

Media containing 1 per cent. glucose, 1 per cent. peptone and 3 per cent. agar were used both for the anaerobic controls inoculated as shake cultures for incubation at 37° C., and the ærobic tests slanted for streak inoculation and incubation at 54° C., in a constant temperature acetone bath. Three per cent. agar was necessary to withstand the latter temperature for the period of the test, fifteen days. Three separate trials were made as follows: In the first, subcultures were made from stock cultures several days old in deep sterilized beef brain. These could not be considered certainly negative due to the resemblance of the transferred brain to surface growth. In the second trial, subcultures were made from 24-hour glucose broth cultures in the constricted tube and marble device for anaerobiosis.[3] Nothing developed on the surface of the slanted agar incubated at 54° C. which could be considered a bacterial growth. This test was repeated with identical results.

In a fourth test, 24-hour glucose broth cultures in constricted tubes were transferred in quantities of 1 c.c. per tube to melted glucose 2 per cent. agar at 42° C. and hardened in the upright position as shake cultures. It was thought that if the premise of this study were true, the greatest growth should occur nearer the surface in the test at 54° C. than in the control incubated at 37° C. But no growth occurred aerobically or anaerobically at 54° C. This test was duplicated in method and results.

The controls at 37° C. gave vigorous growth within 48 hours in every case as evidenced by the distinct and characteristic colonies or opacity and all but four produced abundant gas. The freedom of the control tests from ærobic contamination was also proven by failure of growth on plain agar subplants at 37° C.

Lillian Jordan Ellefson,
Ivan C. Hall

Department of Pathology and Bacteriology,
University of California

[1] Rabinowitch, "Ueber die thermophilen Bakterien," *Zeitschr. f. Hyg.*, 1895, XX., 154.

[2] MacFadyen and Blaxall, "Thermophilic Bacteria," *Jour. Pathology and Bacteriology*, 1896, III., 87.

[3] Hall, "A New Aerobic-Anaerobic Culture Tube," Univ. of Calif. Pub. in Pathology, 1915, II., 147.

BOSTON MEETING OF THE AMERICAN CHEMICAL SOCIETY. II

FERTILIZER DIVISION

J. E. Breckenridge, *Chairman*

F. B. Carpenter, *Secretary*

A new fertilizer: ALFRED H. COWLES and ALFRED W. SCHEIDT. Mr. Cowles referred to a paper read by him before the World's Congress of Chemists in 1912 entitled "Alumina, hydrochloric acid, caustic alkalis and cement by a new process from salt, clay and lime" and explained that a product of that process that he had been intended to convert into cement, has proven itself of greater value as a fertilizer than calcium hydrate. This increased value being due to a discovery made by him that silica in soluble form when either added to the soil by itself or added to the soil as a calcium silicate proved itself to be an essential fertilizer. He explained why clay and zeolitic minerals in the soil would lock up in insoluble form silica when added to the soil in the form of soluble alkali silicates, while the silica would not be thus locked up or bound in insoluble form when added as a soluble type of silica or as an alkali earth silicate. Mr. Cowles gave the quantitative results of a very large number of experiments showing very large gains in luxuriance of growth in a great majority of the plants experimented with, thus confirming the discovery made by Mr. Cowles and his theoretical explanation of the same.

Potash production in United States: H. A. HUSTON. The American production for 1916 was 3.6 per cent. of the imports in 1913. The agricultural effect of impurities in some of the potash from American sources is mentioned.

The synthesis of ammonia by the Haber process: R. O. E. DAVIS and HARRY BRYAN. The use of a catalytic reagent to bring about the union of hydrogen and nitrogen under pressure and at increased temperature is the fundamental idea underlying the Haber process. About one third of the ammonia used in Germany at present is reported to be produced by this method. This is a preliminary report of the study of the process undertaken in the laboratories of the Bureau of Soils, U. S. Department of Agriculture. The apparatus devised for the work is described. This consists essentially of a heating chamber containing the catalytic reagent through which the mixture of hydrogen and nitrogen is passed, a condensing chamber for the removal of the ammonia formed by liquefaction and a circulating pump for the return of the non-combined gases to the reaction chamber. Granular iron reduced by hydrogen is one of the best and most convenient catalyzers.

Effect of fertilizers on composition of strawberries: H. A. HUSTON. Experiments on six varieties of strawberries. Analyses are given showing the effect of nitrogen, phosphoric acid and potash on the density of the juice and on the percentage of acid, invert sugar and sucrose.

The recovery of potash as a by-product in the cement industry: WILLIAM H. ROSS and ALBERT R. MERZ. Analysis of samples of raw mix and of cement from 113 cement plants in the United States and Canada shows that the potash in the raw mix varies from 0.20 to 1.16 per cent., and that the percentage of potash volatilized in the different plants varies from 24.5 to 95.9 per cent. From the results thus obtained it has been calculated that the potash escaping from the kilns of these plants ranges from 0.35 to 5.14 pounds per barrel of cement produced, with an average for the plants of this country of 1.93 pounds. On the basis of an average production of 90,000,000 barrels, the total potash escaping from the cement plants of this country amounts to about 87,000 tons annually. It has been demonstrated commercially that 90 per cent. of the potash escaping in the dust is recoverable, and from experiments made in this laboratory it would appear that 95 per cent. of the recoverable potash is, or may be made, available. The recoverable potash in the cement industry therefore amounts to approximately 78,000 tons and the available recoverable potash to 75,000 tons, or to 71,000 tons when plants losing less than 1 pound of potash per barrel of cement are omitted.

DIVISION OF AGRICULTURAL AND FOOD CHEMISTRY

T. J. Bryan, *Chairman*

Glen. F. Mason, *Secretary*

The influence of season upon the deterioration of food samples: C. A. BROWNE. The influence of season upon the deterioration of raw sugar and butter-fat is discussed. The deterioration of sugar is due to microorganisms, among the most active of which are the budding fungi, such as the Torulæ and Moniliæ, which exert their activity only when the temperature maximum is above 20°

C. This temperature for New York City is from about May fifteenth to October first; from October to May deterioration is quiescent. The deterioration of butter-fat is not due to microorganisms but to auto-oxidation, in which the unsaturated fatty acids act as oxygen carriers. The process is most active for samples exposed to daylight between March and September, when there is a gain in weight; from September to March there is a loss in weight due to volatilization of decomposition products. Chemical action of light, which is greatest about June twentieth, is a pronounced factor in auto-oxidation, although temperature and humidity also play an important part.

DIVISION OF WATER, SEWAGE AND SANITATION

E. H. S. Bailey, *Chairman*

H. P. Corson, *Secretary*

The diffusion of sea water in the Puget Sound and Lake Washington Canal: E. Victor Smith and Thos. G. Thompson. The canal was constructed between Puget Sound and Lakes Union and Washington to give a fresh-water harbor to Seattle. A dam built to control the flow of water during the cutting of the canal was swept away twice, permitting sea water to enter Lake Union. Three years after the second breaking of the dam this lake showed a chlorine content varying from 5,200 parts per million at the bottom, 50 feet, to 17 parts at the surface. Six months later tests showed a decided reduction of chlorine in the upper 40 feet of Lake Union. The difference is due to the inflow of fresh water from Lake Washington and control of tide-water by the lock system. From considerable data authors conclude that an apparently efficient means has been introduced by the government engineers which will prevent the diffusion of sea water into the fresh-water lakes.

On the bactericidal efficiency of soap solutions in power laundering: H. G. Elledge and W. E. McBride. An investigation of the above mentioned subject conducted by the Mellon Institute in behalf of the Laundry Owners' National Association resulted in the following conclusions: The results of these experiments indicate that an infusion-method for testing the bactericidal effect of any agent on an inoculated piece of cloth must not be considered to give more than a relative indication of the actual number of organisms present; that a count on the effluent from any washing bath does not give a true indication of the quantity of organism remaining in the clothes being washed; and that plating a portion of the cloth in question in agar gives a more positive indication. They also show that soap solutions at a temperature of 40° C. have a real bactericidal value. Considering the omnipresence of organisms that, under certain conditions, may be considered pathogenic, it appears absurd to demand that a clothes-washing process should render fabrics absolutely sterile; but it has been demonstrated that such results are actually obtained in the case of all garments that are finished by ironing or drying at high temperatures, and that, in the case of those not so treated, the washing with soap produces a bactericidal efficiency comparable to that obtained by pasteurization.

Manganese in water supplies: J. W. Sale. The water supply of Pierre, South Dakota, contains 2.3 to 3.0 milligrams per liter of manganese and 0.07 milligrams per liter of iron. Water mains in the vicinity of the well become clogged with a deposit of oxids of manganese in a short time. Solubility of the deposit in carbonated water is given. Laboratory experiments on removing the manganese are described and the general subject of manganese in water supplies is discussed.

RUBBER SECTION

L. E. Weber, *Chairman*

John B. Tuttle, *Secretary*

The Rubber Section of the American Chemical Society held its meeting on September 12, the program being as printed in the regular program of the society. About 90 members and guests were present. The meeting authorized the chairman and secretary of the section to appoint an executive committee, the purpose of this committee to be of assistance to the officers in the preparation of programs, meetings and such other matters as may arise. It was decided that a committee should be appointed, to investigate the subject of the poisoning effect of the organic accelerators used in the vulcanization of rubber, the report of this committee to cover a list of such substances, with a description of their effect on the workmen who come in contact with it, and the precautions which should be adopted in the mills to prevent fatal or even serious injury.

Effect of copper on crude rubber: Chas. P. Fox. Reviews the work done along this line. Shows by exhibit of specimens results of experiments with copper acetate on crude rubber. Sustains the work of Dr. Morgan, director of the Rubber Planters' Association, Federated Malay States.